UNIVERSITY OF SASKATCHEWAN

Department of Computer Science

CMPT 424.3 MIDTERM EXAMINATION

November 3rd, 2003

Total Marks: 50

Time: 50 minutes

CLOSED BOOK and CLOSED NOTES
NO CALCULATOR

Instructions

Read each question carefully and write your answer legibly on the examination paper. **No other paper will be accepted.** You may use the backs of pages for rough work but all final answers must be in the spaces provided. The marks for each question are as indicated. Allocate your time accordingly.

Ensure that your name AND student number are clearly written on the examination paper and that your name is on every page.

Question	Marks
1 (6 marks)	
2 (6 marks)	
3 (10 marks)	
4 (14 marks)	
5 (14 marks)	
Total	

Name: _____

Student Number: _____

1. **General** (*6 marks in total – 1 mark for each part*) Give the technical term that best fits each of the following descriptions or definitions.

   (a) A field in a packet header that provides for error detection.

   (b) A type of routing protocol in which each node floods packets to all other nodes that give the costs of its attached links.

   (c) A phase of TCP operation during which the sending rate is increased exponentially fast.

   (d) A flag bit in the TCP segment header that is given a value of 1 only in the connection request and connection granted segments that are exchanged during connection establishment.

   (e) An approach to reliable data transfer in which acknowledgements are individual rather than cumulative, and the receiver buffers out-of-order packets.

   (f) A system that intercepts Web requests and serves them from its cache if a copy of the requested item is found there.

2. **Data Communication Basics** (*6 marks in total*)

(a) (*2 marks*) Consider two communication links *A* and *B*. Link *A* has a propagation delay of 10 ms and a data rate of 1.5 Mbps, while link *B* has a propagation delay of 14 ms and a data rate of 3 Mbps. For what range of packet sizes would the total delay for sending a single packet on link *A* be less than that on link *B*? (Assume queueing and processing delays are the same on the two links.)

(b) (*4 marks*) State the defining characteristics of the *virtual circuit* and *datagram* classes of packet-switched networks, and give one substantive advantage of each approach.

3. **Application Layer** (*10 marks in total*)

(a) (*6 marks*) How is the end of a data object recognized by the receiver, in:

(i) FTP

(ii) HTTP

(iii) SMTP

(b) (*4 marks*) Internet applications have the choice of using either TCP or UDP. For each protocol, list the principal reasons why an application might choose to use it, and give one example application that employs it.

4. **Transport Layer** *(14 marks in total)*

(a) (*4 marks*) Suppose that the "sliding window go-back-*n*" protocol is used with 3 bit sequence numbers. Give an example sequence of events in which the protocol fails (i.e., behaves erroneously) if a sender window size of 8 is permitted.

(b) (*4 marks*) Describe how the retransmission timeout interval is determined in TCP.

(c) (*6 marks*) Consider an FTP session transferring a very large file across the Internet. Suppose that the average round-trip time R and packet loss event probability p were measured during the transfer. Based only on these values, it is possible to conclude that the throughput of the session, measured in segments per unit time, must have been (at best) approximately $1.2/(R\sqrt{p})$, independent of the available bandwidth on the path.

(i) Supposing that the maximum size of a segment is 500 bytes, R = 100 ms, and p = 0.01 (i.e., 1% packet loss), how high a throughput (in bytes/second) could have been achieved, approximately?

(ii) Explain why the above result holds, regardless of whether the average available bandwidth on the path was 500 Mbps or 1 Mbps (for example). (I.e., what is it about TCP that prevents making maximal usage of the available bandwidth in this scenario?)

(iii) Briefly state one approach to modifying TCP so that it can achieve higher throughputs on high bandwidth, high delay links (for example, in the scenario above with the indicated R and p values, and an average available bandwidth of 500 Mbps).

5. **Network Layer** *(14 marks in total)*

(a) (*4 marks*) Give an example of the use of *soft state* by a network layer protocol, and (in the context of your example) describe the possible advantages of using *soft state* vs. using *hard state*.

(b) (*4 marks*) Outline the Internet (IP) multicast service model.

(c) (*6 marks*) Give three examples of the use of *hierarchy* in Internet routing.

The End